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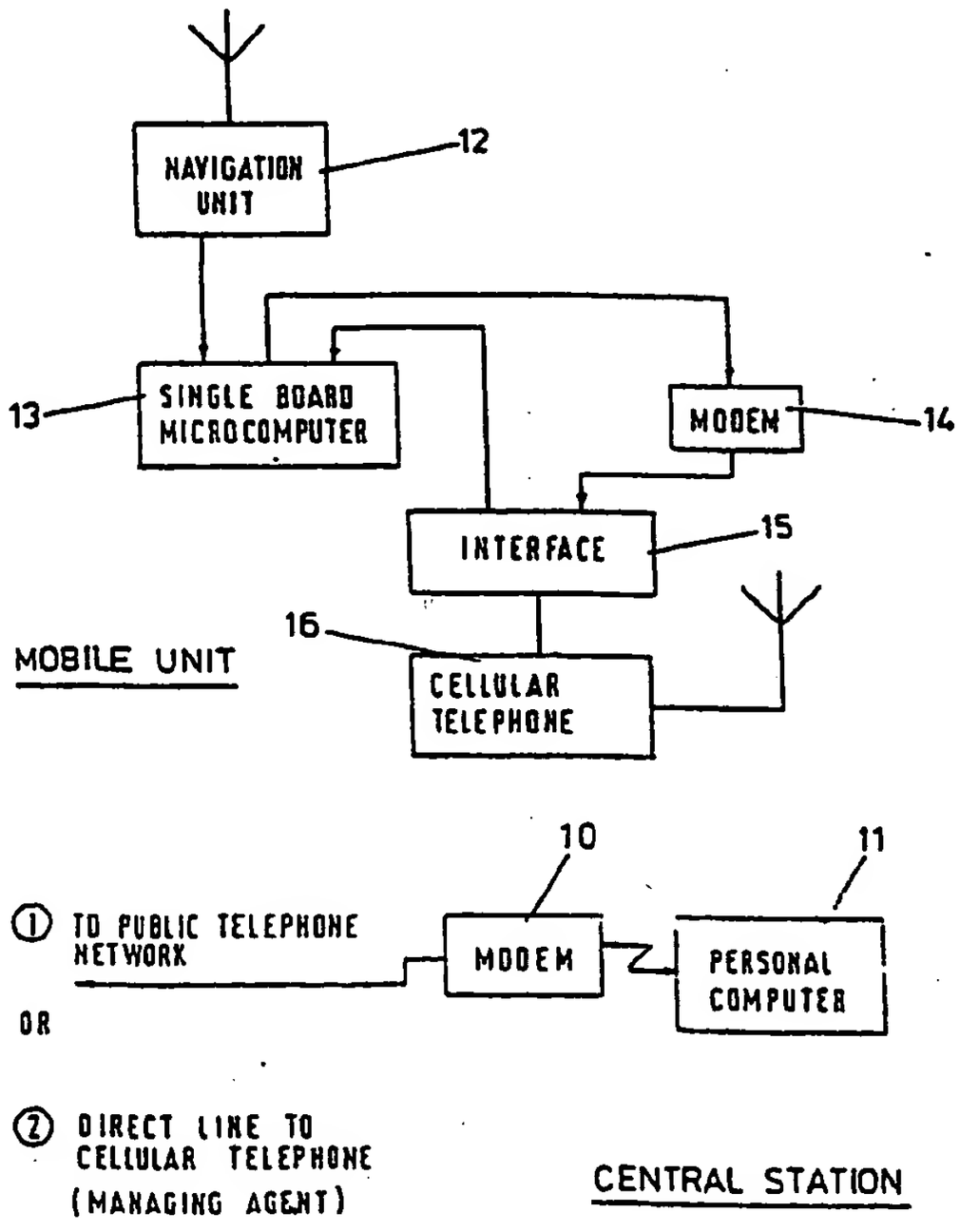
(54) Title: ROAD VEHICLE LOCATING SYSTEM

(57) Abstract

There is disclosed a locating or surveillance system for monitoring the instantaneous position of a mobile object, such as a truck, at a central monitoring or base station. The system comprises a receiving system (10, 11) to be located at the central monitoring station, a navigation unit (12) to be located on the mobile oject and operable automatically to determine the position of the object by reference to orbiting navigation satellites or by reference to land based transmissions or receiving beacons, and a radio telephone type transmitter unit (16) to be located on the mobile unit and connected to the navigation unit (12), the transmitter unit being operable to transmit signals which will be received by the receiving system (10, 11) at the central monitoring station and which are indicative of the instantaneous position of the mobile object as determined by the navigation unit (12).



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ROAD VEHICLE LOCATING SYSTEM

This invention relates to a locating system which enables the location of a mobile object to be monitored on a continuous or intermittent basis at a central monitoring station.

The invention has been developed primarily, though not exclusively, in connection with the surveillance of cars and trucks, though it should be understood that the system of the invention is also applicable generally to the surveillance of mobile objects.

The value of loads carried by trucks can reach very substantial amounts, and it is not unusual for loads of, say, £500,000 to be borne on the public highway on a single vehicle, and to this should be added a typical cost of a heavy duty truck of perhaps £50,000 to £60,000. These figures apply to relatively ordinary items of goods, though of course when high intrinsic value goods, such as bullion or payroll cash is involved, very much higher figures can be involved.

There are in existence surveillance systems for monitoring the location of vehicles, these systems employing small radio "bugs" which can be attached to a vehicle, and which issue a radio signal to be picked-up by a following surveillance vehicle. However, the range of these devices is limited, typically up to about 50 miles, and of course requires the provision of a following surveillance vehicle. There is also a "line of sight" communication system, known as PINPOINT, which operate from fixed observation positions, and may or may not utilise "dead reckoning". Various types of CB radio systems are known also, but they are limited in distances.

It is also known to provide navigation systems for boats, such as the Decca Navigation system, which can provide automatic indication of the instantaneous position of a boat, in latitude and longitude, by use of signals

from land based beacons or orbiting navigational satellites. However, these navigational systems only give a visual indication of the position of the boat on a screen, or may incorporate a printer unit to provide a print-out.

It is also known to provide radio telephone systems, such as Cellnet, and which are gaining wide acceptance for use in cars, and which operate via satellites to be linked into the normal telephone system.

The present invention has been developed primarily with a view to provide a locating or surveillance system which enables the position of mobile objects, such as cars or trucks, to be monitored from a central monitoring station using a telephone receiving system at the central station, and an automatic navigation system and a radio transmission system on board the mobile object for transmitting signals to be received by the central station which will be indicative of the instantaneous position of the object.

According to the invention there is provided a locating or surveillance system for monitoring the instantaneous position of a mobile object at a central monitoring station, in which the system comprises:

a receiving system to be located at the central monitoring station;

a navigation unit to be located on the mobile object and operable automatically to determine the position of the object by reference to orbiting navigational satellites or by reference to land based transmission or receiving beacons; and,

a radio telephone-type transmitter unit to be located on the mobile unit and connected to the navigation unit, the transmitter unit being operable to transmit signals receivable by the receiving system at the central monitoring station and indicative of the instantaneous position of the object as determined by the navigation

unit.

Thus, in use of the system, the positional co-ordinates of the object can be kept under continuous or intermittent surveillance, as desired, at the central monitoring station, and the range of surveillance is only limited by the territory within which radio telephonic communication is possible.

The navigation unit may be generally of the type used for marine navigation, and one preferred form is known as Navstar, manufactured by Polytechnic Electronics, and which is able to give extremely accurate positional indications in longitude and latitude, by reference to orbital navigational satellites or land based beacons.

It is preferred that the system should be designed to operate via the Cellnet radio telephone system, in which case the receiving system at the monitoring station will be designed to be connected to the public telephone via a modem, or by direct line to a "cellular telephone".

In a preferred embodiment, the unit to be mounted on the mobile object comprises a navigation unit, a microcomputer which receives positional data from the navigation unit, a cellular telephone or similar modified to automatically answer an incoming call either by software or hardware changes, a cellular telephone interface unit connected between the cellular telephone and the microcomputer and operable to send a trigger signal to the microcomputer when an incoming call is received on the cellular telephone from the central monitoring station, and a modem connected between the microcomputer and the interface unit to transmit positional data in either serial or parallel format.

The complementary receiving unit to be provided at the central monitoring station is connected to the public telephone network, or by direct line to a cellular telephone - operating as "managing agent", and comprises a modem and a personal microcomputer e.g. a mini computer or

main frame computer. The receiving unit is designed to be able to call up the allocated number of the mobile object, and there is then fed automatically positional data, updated at desired intervals as obtainable by the navogation unit e.g. every 7 seconds, or other period as required.

The unit mounted on the mobile object may include a telephone handset, though the position interrogation via the central station may take place without operation of the handset. Indeed, for customers who do not require a telephone handset to be available to the driver or occupants of the mobile object - usually a truck; the components of the unit may be mounted in concealed positions, so that surveillance can take place without the knowledge of the driver of occupants.

In an alternative embodiment, the mobile unit comprises a navigational system which sends data transmission of positional data (in either serial or parallel format) to an interface unit which takes the serial/parallel data and translates it to either a DTMF toner, or similar, prior to sending the data onwards to a "cellular telephone". The cellular telephone may be provided with an interface unit if required, modified to automatically answer an incoming call, either by software or hardware changes. The complementary receiving unit at the central monitoring station, for this further embodiment, may comprises a DTMF or other interface unit (which may be similar to the interface unit provided on the mobile unit), and which is connected to the public telephone network or by a direct line to a "cellular telephone" operating as a managing agent. The central station unit also includes a personal computer or the like which is connected to the DTMF for the transmission therebetween of serial/parallel data, and provides running communications, with suitable software. The central station may also include a compact disc - read only memory

(CD ROM) or other system holding copies of ordnance survey maps (or other specified maps) for the UK or other countries in which the system is required. Software will be provided which will take the positional data, and from it command the system to find which ordinance survey maps that refers to and displays on screen, with optional hard copy output.

It is envisaged that the locating or surveillance system according to the invention will be of particular value in the monitoring of the transit of high value loads, as well as of vehicles. When the on board transmitting units are suitably concealed, the movement can be tracked at the remote central station, whether the vehicle is being operated by authorised or unauthorised personnel. The accuracy of positional data which can be achieved by existing marine navigational units is of a very high order, and vehicle positions can be determined with an accuracy within 50 yards.

By use of the system, stolen vehicles can be readily tracked, and this will be of great assistance to any organisations seeking to recover stolen vehicles and stolen loads.

The system is therefore believed to be of great potential to police and surveillance authorities, as well as haulage contractors and large companies operating fleets of delivery vehicles.

Embodiments of surveillance system according to the invention will now be described in detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a block diagram of a first embodiment of vehicle surveillance system according to the invention;

Figure 2 is a block diagram of a further embodiment of surveillance system according to the invention; and,

Figure 3 is a block diagram of a modified mobile unit of another embodiment of the invention.

Referring first to Figure 1 of the drawings, there is disclosed a locating or surveillance system which enables the position of mobile objects, such as cars or trucks, to be monitored from a central monitoring station using a receiving system at the central station, and an automatic navigation system and a transmission system on board the mobile object for transmitting signals to be received at the central station and which will be indicative of the instantaneous position of the object.

The system shown in Figure 1 comprises a receiving system located at the central monitoring station and comprising a modem 10 linked to a personal computer 11 and either connected to the public telephone network, or by direct line to a cellular telephone acting as managing agent. The computer 11 may be a mini computer or main frame computer or the like, and provides running communications software, as well as hard copy output. At the central station, it will be possible to dial the number allocated to the mobile object e.g. a truck which is to be under surveillance, and this then initiates an automatic response via a radio telephonic link from position data determined by a navigation unit provided on board the vehicle.

The on board mobile unit comprises a navigation unit 12 which is operable automatically to determine the positional co-ordinates of the truck by reference to orbiting navigation satellites (or to land based transmitting or receiving beacons), and preferably takes the form of the navigational unit known as Navstar, which is made by Polytechnic Electronics. A radio telephone-type transmitter unit is also provided on the mobile unit and is connected to the navigation unit 12, the transmitter unit being operable to transmit signals receivable by the receiving system at the central monitoring station and indicative of the instantaneous position of the object as determined by the navigation unit, given in terms of

latitude and longitude.

In the embodiment shown in Figure 1, the mobile unit includes a single board microcomputer 13, a modem 14, and an interface 15, connected to a cellular telephone 16. Data is fed from the navigation unit 12 to the microcomputer 13, and an output from the microcomputer is fed to the modem 14 in serial or parallel format. Upon a call being made from the central station to the vehicle, a trigger signal is fed back from the interface 15 to the microcomputer 13, to initiate the transmission of positional data from the mobile unit to be received at the central station. The cellular telephone 16, or a similar device, is modified to automatically answer an incoming call either by software or hardware changes.

It is not essential for the mobile unit to be provided with a telephone handset, in which case the components of the entire mobile unit may be mounted in concealed manner on the vehicle, so that secret surveillance can take place, whether the vehicle is being driven by authorised personnel or unauthorised personnel.

An alternative embodiment is illustrated in Figure 2, in which the mobile unit is provided with a navigation unit 12, an interface unit 17 arranged to receive data transmission of positional data in either serial or parallel format from the unit 12, and which takes this data and translates it to either DTMF tones, or the like, prior to sending these data onwards to cellular telephone 18. The cellular telephone is modified to automatically answer an incoming call, either by software or hardware changes.

The complementary receiving unit at the central station comprises a DTMF or other interface unit 19, which may be similar to the interface 17 provided on the mobile unit, a personal computer 20 connected for transmission of serial/parallel data, and a line for connecting the DTMF to the public telephone network, or a direct line to the cellular telephone. The personal computer 20 may be a mini

computer or main frame computer, and provided with running communications software and hard copy facility.

Although not shown, a modification to the central or base station may include a compact disc read only memory system (CD ROM), holding copies of ordinance survey maps for UK or other countries, and software which will take the positional data received and from it command the system to find which ordinance survey map that refers to and display on screen, with optional hard copy output.

Referring now to Figure 3 of the drawings, there is shown a modified arrangement for incorporation in the mobile unit to be provided on the mobile object whose location is to be monitored and surveilled. In this modified embodiment, a multi-functional interface 115 is provided, which is connected to data generator 112 to receive data therefrom, and which may comprise a suitable navigation unit. The interface 115 is also connected via its output to a radio/cellular system 116, for onward transmission of positional data to the receiving system at the central monitoring station. In addition, the multifunctional interface 115 is coupled with a disabling unit 117, and the interface 115 may be arranged, upon receipt of a coded signal from the central monitoring station (which will be arranged not to be apparent to the driver of the vehicle) so as to cause automatic disabling of the mobile object, which may be a truck. The disabling unit may be coupled up with any suitable part of the vehicle to prevent its motion, such as a fuel switch-off device in a hidden position, or some means for automatically applying the brakes.

Thus, if it becomes apparent that the truck has been stolen, or is being driven by unauthorised personnel, a signal can be sent from the central monitoring station to be received by the mobile unit, and which disables the vehicle.

The multi-functional interface 115 therefore can have

one or more of the following capabilities:

(1) it can function as a bi-directional data logger, which captures and transmits data from a navigation unit to be retransmitted to the base station via a radio type transmission system;

(2) it may have encription capability, or not, depending on whether this may be required;

(3) it may have a facility for line protocol and error collection facilities;

(4) it may incorporate a control unit which is capable of switching any handset which may be provided on or off, or can be used to disable the vehicle via the disabling unit; and,

(5) it functions as an interface to a radio or radio telephone, a PMR or a satellite system.

CLAIMS

1. A locating or surveillance system for monitoring the instantaneous position of a mobile object at a central monitoring station, in which the system comprises:

a receiving system to be located at the central monitoring station;

a navigation unit to be located on the mobile object and operable automatically to determine the position of the object by reference to orbiting navigational satellites or by reference to land based transmission or receiving beacons; and

a radio telephone-type transmitter unit to be located on the mobile unit and connected to the navigation unit, the transmitter unit being operable to transmit signals receivable by the receiving system at the central monitoring station and indicative of the instantaneous position of the object as determined by the navigation unit.

2. A system according to Claim 1, in which the navigation unit is able to give accurate positional indications in longitude and latitude, by reference to orbital navigational satellites or land based beacons.

3. A system according to Claim 1 or 2, in which the receiving system includes a modem for connection to the public telephone or by direct line to a cellular telephone.

4. A system according to any one of Claims 1 to 3, in which the unit to be mounted on the mobile object comprises said navigation unit, a microcomputer connected to receive positional data from the navigation unit, a cellular telephone or similar modified to automatically answer an incoming call either by software or hardware changes, a cellular telephone interface unit connected between the cellular telephone and the microcomputer and operable to send a trigger signal to the microcomputer when an incoming call is received on the cellular telephone from the central

monitoring station, and a modem connected between the microcomputer and the interface unit to transmit positional data in either serial or parallel format.

5. A system according to Claim 4, including a complementary receiving unit to be provided at the central monitoring station for connection to the public telephone network, or by direct line to a cellular telephone, and which comprises a modem and a personal microcomputer, said receiving unit being designed to be able to call up the allocated number of the mobile object, so as to be fed automatically with positional data, updated at desired intervals as obtainable by the navigation unit.

6. A system according to Claim 4 or 5, in which the unit to be mounted on the mobile object includes a telephone hand set.

7. A system according to Claim 1, in which the mobile unit comprises a navigational system operable to send data transmission of positional data, in either serial or parallel format, to an interface unit which takes the data and translates it to either a DTMF toner, or the like, prior to sending the data onwards to a cellular telephone.

8. A system according to Claim 7, in which the cellular telephone is provided with an interface unit modified to automatically answer an incoming call, either by software or hardware changes.

9. A system according to Claim 8, including a complementary receiving unit to be arranged at the central monitoring station, and which comprises a DTMF or other interface unit, and which is connectable to the public telephone network or by a direct line to a cellular telephone operating as a managing agent.

10. A system according to Claim 9, in which the complementary receiving unit also includes a personal computer which is connected to the DTMF for the transmission therebetween of serial / parallel data, and provides running communications with suitable software.

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11. A system according to Claim 10, in which the receiving unit also includes a compact disc-read only memory (CD ROM) or other system for holding a map of the area in which the system is required.

12. A system according to any one of Claims 1 to 11, in which a mobile unit to be provided on the mobile object includes a multi-functional interface arranged to capture and transmit data received from the navigation unit to the receiving system to be located at the central monitoring station, said multi-functional interface having one or more of the following capabilities:

(1) encription if required;

(2) line protocol and error collection facilities;

(3) function as a control unit to disable the mobile object on which it is to be provided;

(4) act as an interface to a radio or radio telephone, PMR or satellite system.

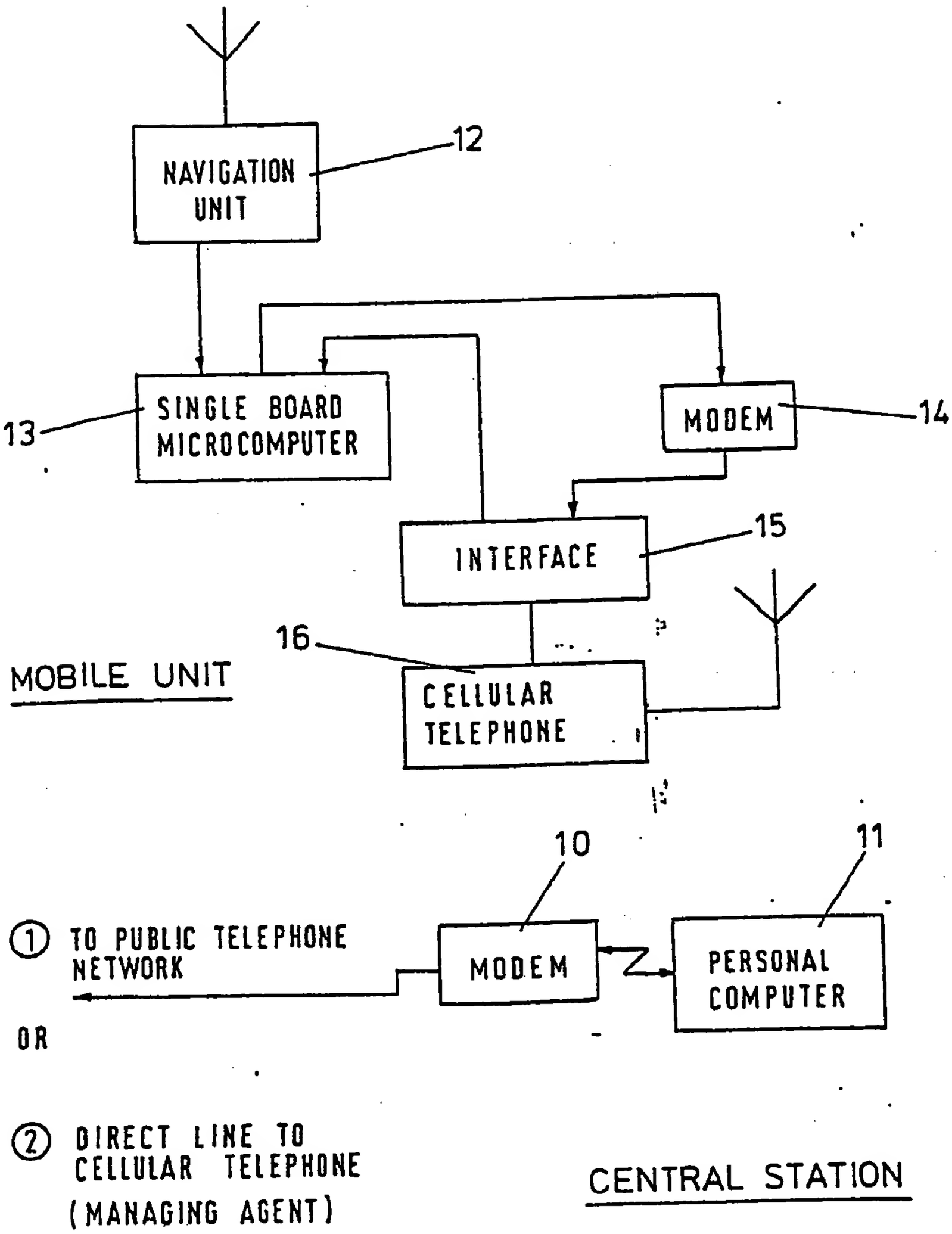
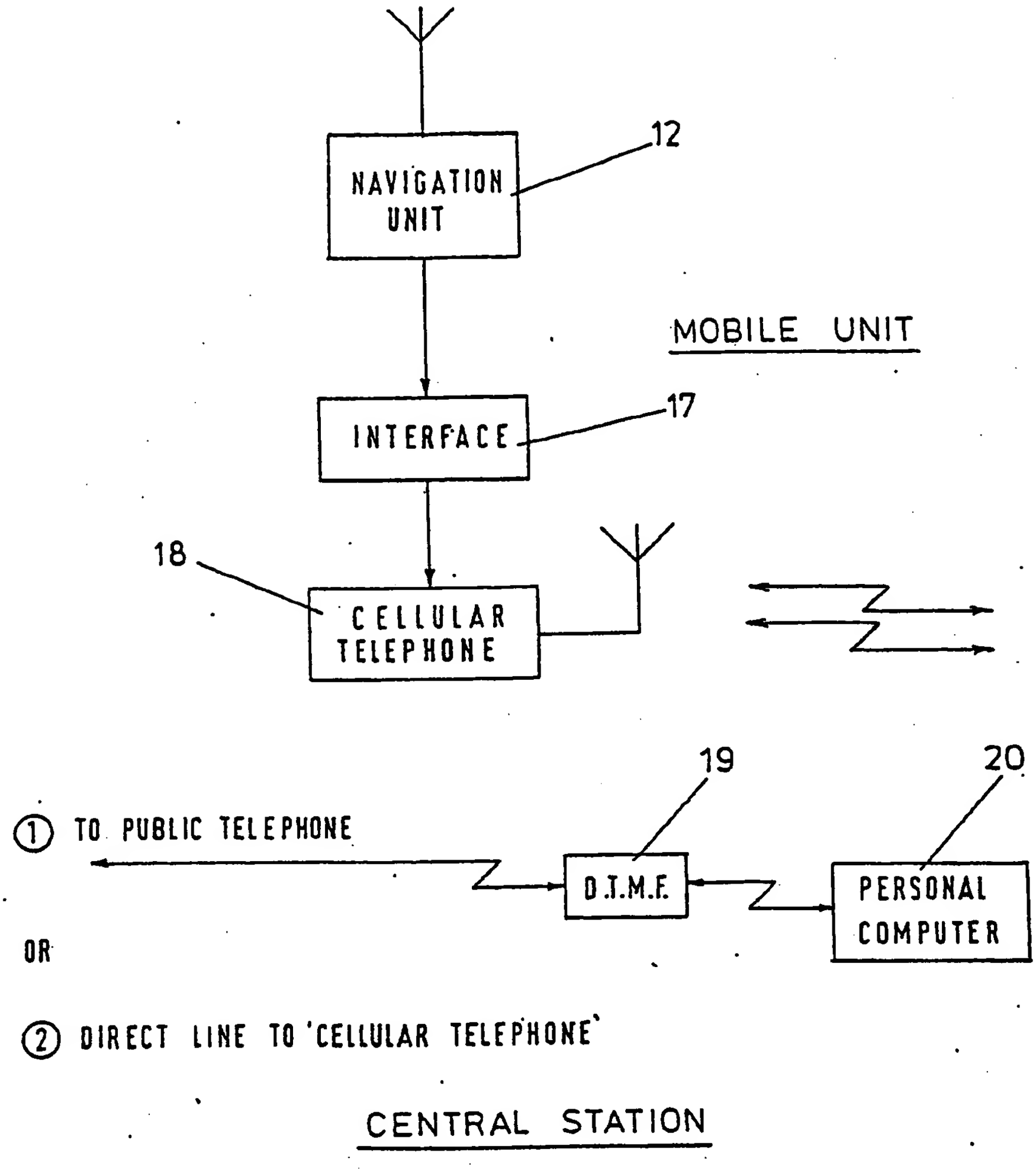

NAVIGATION UNIT
12
SINGLE BOARD MICROCOMPUTER
13
MODEM
14
INTERFACE
15
16
CELLULAR TELEPHONE
MOBILE UNIT
10
11
MODEM
PERSONAL COMPUTER
① TO PUBLIC TELEPHONE NETWORK
OR
② DIRECT LINE TO CELLULAR TELEPHONE (MANAGING AGENT)
CENTRAL STATION

FIG. 1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MOBILE UNIT
INTERFACE
17
18
CELLULAR TELEPHONE
19
20
① TO PUBLIC TELEPHONE
D.T.M.F.
PERSONAL COMPUTER
OR
② DIRECT LINE TO 'CELLULAR TELEPHONE'
CENTRAL STATION

FIG. 2

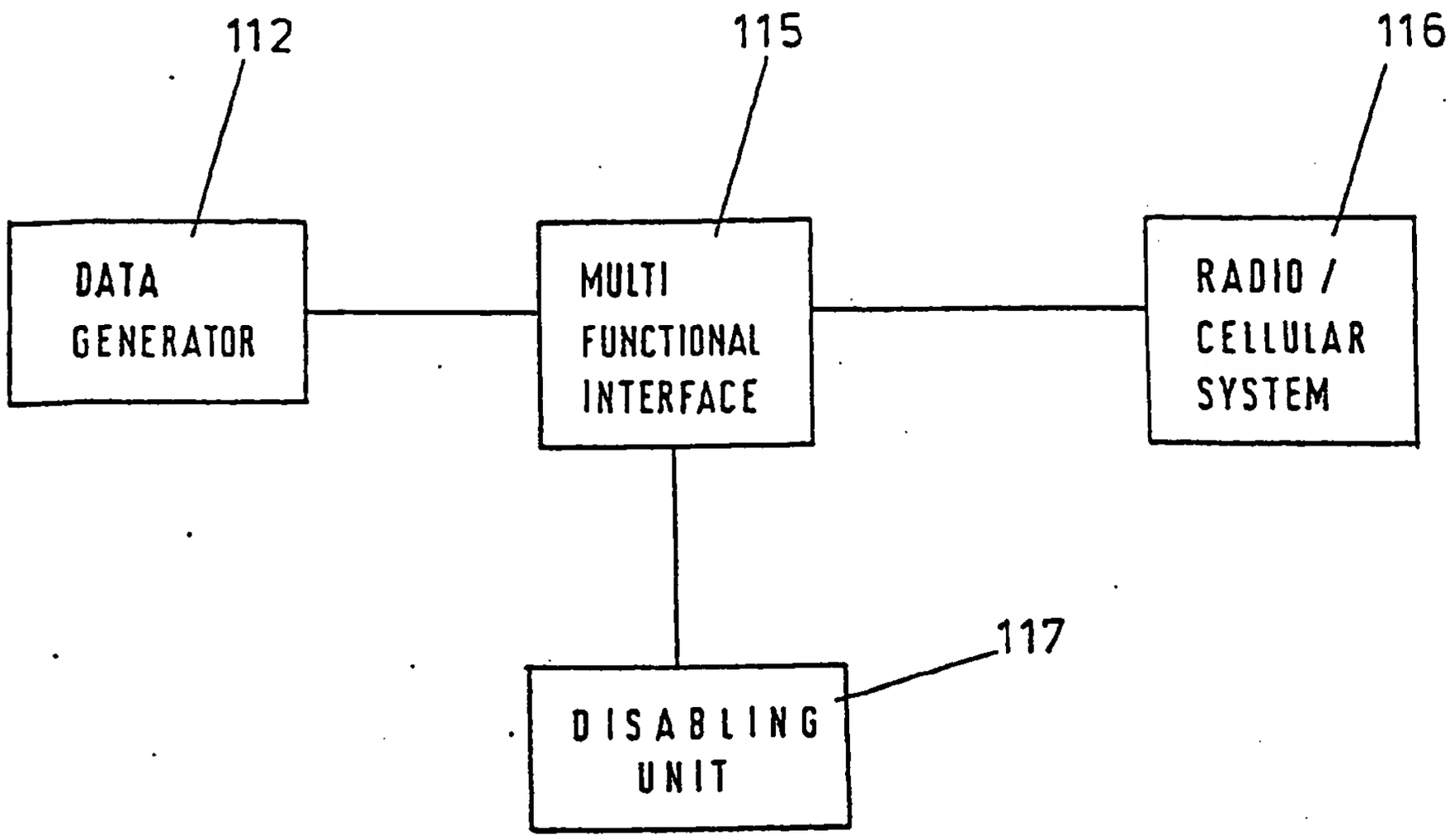
112
115
116
DATA GENERATOR
MULTI FUNCTIONAL INTERFACE
RADIO / CELLULAR SYSTEM
117
DISABLING UNIT

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 89/00673

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: G 01 S 5/02, G 08 G 1/12

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	G 01 S, G 08 G, H 04 Q

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	EP, A, 0242099 (ADVANCED STRATEGICS, INC.) 21 October 1987, see the whole document --	1-5,7-9
X	FR, A, 2541801 (AERAC Sarl) 31 August 1984, see the whole document --	1-5,7-9
A	US, A, 4596988 (WANKA) 24 June 1986, see the whole document --	1
A	US, A, 4651156 (MARTINEZ) 17 March 1987, see the whole document --	1-3
A	EP, A, 0199266 (SIEMENS AG) 29 October 1986, see the whole document --	1-3
A	Wescon Technical Papers, vol. 20, 1978, paper no. 20/4 (Hollywood, US), J.S. Bravman et al.: "Automatic vehicle monitoring", pages 1-10, see the whole article --	1-3

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- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
8th September 1989	11 OCT. 1989
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	T.K. WILLIS

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	EP, A, 0123562 (BRITISH TELECOM) 31 October 1984, see the whole document --	1-5,7-9
X	US, A, 4651157 (GRAY et al.) 17 March 1987, see the whole document ----	1-5,7-9

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8900673 SA 29315

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 26/09/89
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A- 0242099	21-10-87	JP-A- 63024395	01-02-88
FR-A- 2541801	31-08-84	None	
US-A- 4596988	24-06-86	None	
US-A- 4651156	17-03-87	CA-A- 1217841	07-02-87
EP-A- 0199266	29-10-86	None	
EP-A- 0123562	31-10-84	None	
US-A- 4651157	17-03-87	None	